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MAN THE CONQUEROR[1]

Every man with a drop of red blood who has been following the gallant attempts of the Third Everest Expedition to scale the peak of the Queen of Mountains will wish to accept the belief now held by Lieutenant Colonel Norton, leader of the expedition, that his lost comrades, Messrs. Mallory and Irvine, before they perished actually stood upon the topmost crest.

The world has too few of these bold and steadfast pioneers, who will go happily to poverty or to death to reach a goal that has never been reached before and who see no less glory in failure than in success, provided only that they do their best and keep up the fight as long as life is in them. And yet we can point to some fine specimens of the breed. Some of them have been flying around the globe. Some are giving their lives to stamp out devastating diseases.

Mr. Richard O. Marsh and his fearless companions braved hardship, pestilence and all the perils of the Isthmian jungle before they found the lost tribe of blond Indians; and Prof. J. L. Baer, of the Smithsonian Institution, and Mr. Paul Brin, the Panamanian botanist, perished in the attempt. Other men of the same breed dedicate their lives to reaching that spot of earth where there is no direction but south; and their brethren of the laboratories, no less devoted, labor day and night to trap an unseen atom and learn the motions of its invisible members, as though they were the steps of a new dance.

Of such is the vanguard of humanity. Such are the men who haul the rest of their kind after them and set up the new milestones of human progress. Whatever task they undertake, these leaders have one character in common: They are the officers who direct man's age-old warfare against Nature; and they head an army that continually marches on from victory to victory and leaves many a dead captain by the way.

Sir Francis Younghusband, the distinguished Tibetan explorer, publishes in the *London Times* a stirring article in which he argues that the eventual conquest of Everest is a foregone conclusion. It is worthy of more extended

[1] Editorial in Saturday Evening Post.

quotation than space permits, not only on account of the world-wide interest in the subject but also because the author's argument applies to every field of Nature that man has determined to penetrate and conquer for his race. Thus Sir Francis:

> The doom of Everest is sealed; and for one simple, one very obvious reason. Man grows in wisdom and stature; but the mountain's stature is fixed. Man can exalt the spirit within him, but the mountain cannot add a single cubit to her measure . . . He finds means to outwit the mountain's allies. And each throw he receives only heightens his spirit. He quickly recovers himself, and undaunted returns to the battle. While the mountain forever remains fixed, the spirit of man can heighten itself—can rise higher and higher as the battle demands and occasion requires. As man looks up to the hills and earnestly strives to attain them his spirit increases within him.

Sir Francis goes on to survey the history of mountain climbing during the past forty years. A generation or more ago, 21,000 feet was the Ultima Thule of altitude. Twenty years ago the limit had been advanced to 23,000 feet, and so on until, a few weeks ago, Colonel Norton's expedition reached 28,000. Sir Francis reasons: "21, 23, 25, 27, 28—arithmetic itself shows that 29 must follow and Everest is vanquished."

And then he pictures the sight that brave eyes will some day behold:

> A sea of peaks will stretch all round him. Kingdoms, principalities, and powers far down below will lie submerged in bluey haze. Raised high above the rest of earth he will feel himself to be, and to have reached a region of sternest austerity, indeed, but loftier, purer, clearer, and of more dazzling radiance and farther stretching horizon than man had ever known before. And his vision will be all the more intense because he will have won this glory for himself by his own unaided efforts. And ever after as man looks upward at Mt. Everest it will not be with a craven sense of his own littleness beside her. He will then be justly proud of his own greatness. Supremely lofty as she is among all mountains, he will know for certain that his own spirit can exalt him higher still.

As man has conquered lesser peaks, so will he conquer Everest. As he has put down smallpox and tuberculosis, so will he put down cancer and infantile paralysis. Presently we shall have cold light and derive our power from the energy of the sun. We shall understand the constitution of matter, we shall know more about the mysteries of time and space.

Those who dare the mountain tops will achieve; and we who grub in the valleys shall enjoy the fruits of their labors—but their visions we shall never see.

—*Saturday Evening Post.*

PUBLISHED CONTRIBUTIONS OF COLLEGE OF AGRICULTURE: II[1]

By CHARLES FULLER BAKER
Dean, College of Agriculture

Again we take pleasure and pride in presenting evidences of the intellectual activity which continues to characterize the staff of the College of Agriculture. This continued heavy output is the more noteworthy when we consider the conditions under which it is produced. The College is still unable to obtain the support it should have for the experiment station work essential to the proper functioning of an institution of this type. The staff has been gradually growing weaker since 1920, due to the leaving of many members without adequate replacement, and failure to obtain additional men to handle the constantly growing instructional work. This has meant overloads for those who remain. It is highly remarkable that the proportion of original output remains much the same even under these conditions. It is proof positive of the existence here of vital interest in investigation and in extension of knowledge, and of the existence of a spirit of high emprise and "derring-do" that triumphs over difficulties and obstacles. It is our highest hope that this College may become the permanent natural home and prolific source of this type of spirit. Such a spirit is one of the most valuable national assets that any country may possess—something not to be purchased in any market of the world—something infinitely above money values.

The field of possible points of attack by our workers is sadly limited by lack of sufficient time, needed facilities, and adequate assistance. Therefore the first consideration in selection of subjects is not the greatest needs of the agriculture of the country, but rather what is feasible and practicable under the existing circumstances. We have few cases of repining over what cannot be done. Instead, in all directions one finds here the most active and concentrated attack on the simpler problems, no matter how restricted, that give reasonable promise of attainable results. This attitude is one of the finest and one of the most promising things that I find in the College of today. Making the best of *things as they are,* together with concerted attack on the problems nearest at hand, no matter how simple or restricted, will certainly result in time in material advance of agricultural science, and in effective uplifting of the University and of the Filipino people.

Accomplishment under existing circumstances means much overtime work, much self-sacrifice, and often personal expense, but the producing student and investigator finds true reward—and a great reward it is—in accomplishment for its own sake. *Quo potui perfeci.*

I: TECHNICAL CONTRIBUTIONS 1909-1918

For the 184 contributions published before the establishment of the Experiment Station, *see* the PHILIPPINE AGRICULTURIST, XII, No. 7, December, 1923.

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[1] General Contribution from the College of Agriculture, No. 137.

II: EXPERIMENT STATION CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1-199 *see* PHILIPPINE AGRICULTURIST XII, No. 7, December, 1923.

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III: GENERAL CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1-104 *see* PHILIPPINE AGRICULTURIST XII, No. 7, December, 1923.

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IV: CIRCULARS

No. 1. GONZALEZ, B. M. Hog raising for beginners, 1924. (*See* Experiment Station contribution, No. 224.)

No. 2. OCFEMIA, G. O. Bud rot of coconut. 1924. (Mimeographed.) (Experiment Station contribution, No. 257.)

No. 3. MENDIOLA, N. B. Experimental errors and application of the probable error to and the interpretation of experimental results. 1924. (Mimeographed.) (Experiment Station contribution No. 258.)

No. 4. MONDOÑEDO, MARIANO. Curing ham and bacon for home use. 1924. (*See* Experiment Station contribution No. 250.)

No. 5. FRONDA, F. M. A guide for beginners in chicken raising. 1924. (*See* Experiment Station contribution No. 261.)

SOME METHODS OF ASEXUAL PROPAGATION OF THE AVOCADO[1]

By Leon G. Gonzalez

INTRODUCTION

Although the avocado (*Persea americana* Mill) was introduced into the Philippines only recently, it has already won a fair name. In the College of Agriculture alone, there are hundreds of requests for seeds waiting to be filled. The Bureau of Agriculture at Manila has distributed thousands of plants and many requests remain unfilled.

With the growing recognition of the importance of the avocado, a problem presents itself for solution: that of finding an efficient means of propagating it asexually for the better perpetuation of its many good varieties. It is well known that the seedlings of most fruit trees do not come "true to type" and the avocado is not an exception in this respect. Several means of asexual propagation known to horticulturists have been tried with varying success. Shield budding, cleft grafting, cion budding, marcottage, and propagation by cuttings have all been reported. Various adaptations of these practices are recorded as having been more or less successful, but there is as yet no uniformity of practice. It was with a view of testing the suitability of these practices to such conditions as exist at the College of Agriculture and devising the adaptations necessary for the highest success that the present work was undertaken. The first investigations were made with shield budding. Others included bark grafting and a form of cleft grafting, cuttage, and marcottage.

The experiments reported in this paper were conducted in the field nurseries of the College of Agriculture at Los Baños. The work was begun in October, 1921.

SHIELD BUDDING

MATERIALS AND METHODS

Buds and budwood.—In order to find the merits of buds in the different branches for shield budding work, different flushes of budwood were used. Buds were taken from the first flush, or the latest growth that the branch had made. Buds were cut also from the second flush where the wood was more mature. Finally, buds were obtained from the ripened wood of the third flush or older.

Examination of buds of avocado will reveal many forms. They differ very widely in different varieties and often to a considerable degree even on the same tree or the same branch. A brief description of three typical forms which were used in this work is here given. First, there is a form rather pointed and thin; the young bracts are very narrow and hairy. Another form is plump, well developed, almost rounded; the bracts are heart-shaped and are well placed, making a hard prominent bud which seems ready to burst open. Sometimes miniature leaflets, quite loose at the top may be seen in a few varieties. This seems to be a varietal character, but even in these, the buds are hard and compact within.

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[1] Thesis presented for the degree of Master of Science in Agronomy, University of the Philippines, No. 198; Experiment Station contribution No. 280.

The third form is also rounded but very much smaller than the second and it seems to be in a dormant condition. It is really intermediate between the two forms. These three forms were used in this experiment.

There are several opinions as regards the length and thickness at which the shield should be cut. There are some horticulturists who cut the shield unusually long, about five centimeters. There are others who cut it about four centimeters long but cut it deep, allowing a thicker slice of wood to remain with the shield. Others cut it thick and long. There are a few who would exclude the wood from the bud, and there are some who are quite indifferent as to the manner of cutting the bud.

To find if the mode of cutting the shield has anything to do with the success of the budding operation, these different methods of cutting were used. In every case the budding knife was kept very sharp.

The method of tieing the bud after it is inserted varies according to different horticulturists. Higgins (1) used raffia for tieing above and below the bud, and then wrapped the whole with grafting tape. Rolfs (2) left an opening for the "eye" of the bud in tieing. Barber (3) cut his bud leaving a short petiole, an opening for the "eye" was also left. Wester (4) recommended covering the whole bud for better protection against excessive evaporation or the entrance of water into the bud. With a view to finding possible advantages in the use of any of these methods, the different ways were made a subject of experiment.

The budding tape used was made of cheese cloth dipped in a melted mixture of equal parts of beeswax and paraffin. In some parts of the experiments branches of old avocado trees were used as stocks. New sprouts were obtained by cutting the main branches of the tree, leaving one branch of fair size uncut to afford some shade and maintain growth. The branches were cut to about one third of a meter from the point of union with the main trunk.

In every case the inverted "T" method of incision was used. An incision depending on the length of the shield desired was made by using the curved portion of the blade and placing it lengthwise at an angle of 25° with the stem of the stock. A curved cut across the extreme lower end of the incision was made, with a slight raise at the point of intersection of the two cuts to start slipping the bark. Then with the bone handle of the budding knife, the bark was raised exerting the pressure against the bark to avoid, as much as possible, bruising the cambium layer. Sometimes better fit between the bud shield and stock was obtained by pushing the former into place without lifting the bark with the bone handle of the knife. This was more convenient with buds where a short petiole was left attached.

The shield was then cut to the length and thickness desired. The budstick which had been prepared in advance in the usual manner was placed in the left hand with the upper point towards the body. The knife was placed at an angle of about 45° and the shield was cut from the lower end of the bud to the upper part. The shield was then placed in the incision. It was necessary to place two fingers against the sides of the bark at the point of incision to regulate the amount of opening, then with a slight pressure on the bone handle of the knife the shield was pushed into position. Where a short petiole is left attached to the shield the bud can be easily pushed into place with the finger. Tieing was then done according to the method desired. In every case tieing began at the bottom and proceeded upward.

Forcing was done as practiced by Higgins and confirmed by Cuitiong (5).

EXPERIMENT AND RESULTS

Value of different flushes as budwood.—This experiment was to determine the value of different flushes as budwood. Using young, medium-ripened, and matured branches as sources of shield buds and young branches of rejuvenated[2] avocado trees for stocks, the respective value of the different flushes was tested. Twenty shield buds were cut from each flush and inserted in the stocks. The experiment was run twice with the results indicated in Table I.

TABLE I.—*Test of budwood.*

Flush.	No. of buds put in each set.	Percentage of success.		Percentage blind.		Percentage dead.	
		First set.	Second set.	First set.	Second set.	First set.	Second set.
First.....	20	80	90	10	—	10	10
Second.....	20	90	80	—	5	10	5
Third.....	20	80	80	10	10	10	10

Bud development and its correlation with success.—While the above experiment was going on note was taken of the different development of the buds. Some of all forms were seen in each of the three flushes and this fact led to the suspicion that one form of bud may be better suited for budding than another. In this connection choice was made so that 6 of the 20 buds cut from the first flush were plump and rounded, six were intermediate in form, and six were pointed. The same selection was made with the second and third flushes. In each case it was found that there was always a higher percentage of success in using the plump and well developed bud, irrespective of whether it was taken from young or matured budwood. The buds that were not well developed but rounded in form came next, though leading in percentage of blind ones. The pointed bud made the poorest showing.

It was interesting to note that the rate of growth of the buds after insertion had a direct relation to the degree of their development when set. As a general rule, well developed buds started to grow after three or four weeks, while poorly developed ones remained dormant for six months often, resulting in poor, weak shoots. Results in bud selection are shown on Table II.

TABLE II.—*Showing results of bud selection.*

Flush.	Buds used.	Plump.	Intermediate.	Pointed.	Living.			Blind.		
					Plump.	Intermediate.	Pointed.	Plump.	Intermediate.	Pointed.
				First set						
First.....	18	6	6	6	5	4	2	—	1	—
Second....	18	6	6	6	5	3	2	—	2	—
Third.....	18	6	6	6	4	3	1	1	2	1
				Second set						
First.....	18	6	6	6	4	3	2	1	1	—
Second....	18	6	6	6	6	4	3	—	1	—
Third.....	18	6	6	6	4	3	2	—	—	—

[2] The term "rejuvenated" is here used to designate those trees which had been cut back and had produced new shoots.

Cutting the bud.—The shield buds used in the foregoing experiments were cut four centimeters long with a thin piece of wood attached to the bark. Different opinions among workers on the avocado as regards length and thickness of the shield and the advisability of leaving a short petiole attached to the bud, suggested trying an experiment using varying lengths and thickness of buds, with and without petiole left attached.

Using half ripened budwood with buds well developed and plump, 20 shields each were cut and inserted as follows: Twenty were cut five centimeters long and about two millimeters thick; 20, five centimeters long and about one millimeter thick; and 20, four centimeters long and one millimeter thick. Of each of these three sets of 20 buds, 10 were cut without petiole and 10 with petiole 1.5 centimeters in length. Young shoots of two avocado trees of the same variety were used as stocks. These shoots were about the size of a lead pencil and apparently in a very active stage of growth.

The experiment was duplicated for checking. The results of both are shown in Table III.

TABLE III.—*Showing results of petioled and non-petioled bud shields cut in varying lengths.*

Set No.	Size of shield.	Petioled or non-petioled.	Buds put in.	Buds living.	Percentage of success.
First	Short and thin	With petiole	10	9	90
		Without petiole	10	7	70
	Long and thin	With petiole	10	10	100
		Without petiole	10	8	80
	Long and thick	With petiole	10	8	80
		Without petiole	10	6	60
Second	Short and thin	With petiole	10	10	100
		Without petiole	10	7	70
	Long and thin	With petiole	10	8	80
		Without petiole	10	8	80
	Long and thick	With petiole	10	9	90
		Without petiole	10	7	70

Different methods of tieing.—Cuitiong (5), experimenting on the effects of various tieing materials for budding avocado, concluded that tape prepared by soaking in equal parts of beeswax and paraffin was best suited for the work. Using this tape different methods of tieing were experimented with.

Twenty buds four centimeters long with a thin piece of wood were cut and completely covered with tape, cut 1.5 centimeters wide. Winding was begun below the incisions in the stock and continued upward till the wound was covered. Twenty other buds were tied following the same procedure except that the "eye" of the bud was left exposed. Twenty more were tied with a narrow strip of tape below and above the bud in similar way to that used by Higgins (1). Then tape 1.5 centimeters wide was applied as in the first method. Young shoots of rejuvenated trees were used for stocks. The experiment was duplicated.

TABLE IV.—*Showing results of different methods of tieing buds.*

	No. of buds.	Living.	Percentage of success.
First set			
Completely wrapped	20	15	75
With opening	20	18	90
Tied and wrapped	20	16	80
Second set			
Completely wrapped	20	15	75
With opening	20	17	85
Tied and wrapped	20	14	70

Observation showed that the buds covered with tape had to be uncovered in 10 to 12 days after budding, otherwise the buds became brownish in color suggesting the effects of pressure. When the bud was exposed, less care in the way of releasing was necessary. It was also noted that, in a majority of cases, the buds that were exposed developed earlier. Extra care had to be exercised with the buds that were tied with a narrow strip of tape as ringing soon followed. The narrow tape had to be loosened weekly.

General check experiments.—For better confirmation of the results obtained and to avoid using an unnecessary number of stocks, two additional sets of experiments were performed, using only those methods and materials which the earlier results indicated as desirable. Young vigorous seedlings 1.5 to 2 centimeters in diameter were used for stocks. Buds were plump and well developed. They were cut four centimeters long with a piece of wood of medium thickness and leaving 1.5 centimeters of the petiole attached to the bud. Tieing was done by using tape of the formula used above, cut 1.5 centimeters wide. The "eye" of the bud was left exposed in wrapping, but the opening was always small. Fifty seedlings were budded in each set.

In the first set, 48 buds took, two of which were "blind". There was a total of 96 per cent united including four per cent "blind". Four per cent failed to unite.

In the second set, 45 buds took, three of which were "blind". There was a total of 96 per cent united including six per cent "blind". Four per cent failed to unite.

It might be of interest to make a comparison of the results in budding obtained by two classes in Tropical Pomology under the supervision of the writer. The members of the Class in 1921-1922 put in 172 buds. The buds were of various forms and cut from different flushes, one to four centimeters in length, with a thin piece of wood. No petiole was left with the shield. Young shoots of rejuvenated avocado trees were used as stocks. The buds were completely wrapped with tape prepared as in the earlier experiments. Seventy-eight buds took, 22 were "blind" and the rest died. This is the equivalent of 45.34 per cent successful; 12.79 per cent, "blind"; and 41.27 per cent, dead.

A similar experiment in budding of the avocado was conducted by the 1922-1923 class who also used young shoots of old seedlings as stocks. All buds used were well developed and plump, cut about four centimeters long, leaving a thin piece of wood attached to the shield and a short petiole about 1.5 centimeters in length. In tieing, tape of formula given above was used, but the "eye" and the

petiole were left exposed. Ninety-five buds in all were put in. Of these, 81 were successful, nine "blind," and the rest died. The results were thus 85.25 per cent successful; 9.47 per cent, "blind"; and 5.26 per cent, dead.

Seasonal effects.—Cuitiong (5), working on the effects of the season upon the success of budding, found that buds put in on rainy days tended to rot before union was effected. The trouble was attributed to harmful fungi which naturally abound in rainy weather and also to some form of enzymes. Buds inserted on days when sunlight was intense were very much affected by the heat. To prevent these ill effects, Cuitiong used a shed in rainy weather and liberal watering when budding on sunny days.

In the present work, budding was done mostly when there were few rainy days and when the intensity of the sun was not so great as to injure to any appreciable degree.

Forcing the buds.—Higgins and his co-workers in their bulletin on" The Avocado in Hawaii" (1) say:

> * * * To force the bud into growth a process of incomplete girdling has been adopted. A portion of the bark about one-half to three-quarters of an inch wide is removed a few inches above the bud throughout the circumference of the stock, with the exception of about a quarter of an inch or less on the side opposite the bud. This conveys a portion of the sap upward and forces a large part of it into the bud. When the bud has opened the stock may be cut off where girdled. Cutting back close to the bud should not be done until the latter has made a growth of several inches.

Cuitiong experimented on the effects of various means of forcing the bud. He employed the method described by Higgins and his co-workers, and, in addition, tried defoliating the stock. In another set of experiments, buds of all kinds were removed and the stock kept free from them. His results were in favor of Higgins' method.

In the experiments recorded in the present paper forcing of buds was done as described by Higgins.

DISCUSSION OF RESULTS

Comparing the merits of three flushes as budsticks it is seen that the first and second furnish the larger number of desirable buds. In the course of the experiment there were times when the first flush buds did better than the second and other times when the reverse was true. This experiment was performed without reference to the classification of buds, as described above, as no such classification at that time had been made. It appears probable that well developed buds from the first flush can not be excelled by any other, at least for inserting in young green bark. Many buds found on the third flush deteriorated, and not a few fell off entirely. "Blind" buds were always obtained more abundantly from the third flush.

Of the three forms of buds tried, the one described as plump and well developed proved to be the best. This superiority may be due to a greater amount of stored nutriment in the buds. It may be possible that prolonged dormancy has a deteriorating effect on the bud, tending to lower its vitality.

The length and thickness of the shield did not have a marked influence on the effectiveness of the work. In the matter of the length of bud shield there

was no uniformity of results, which suggests that there may be no advantage in a cut of extra length. Likewise the thickness of the bud produced no evident difference in the result. The writer is of the opinion that experience in cutting buds so as to secure an even surface is more important than the dimensions of the shield. Better results appeared to follow when the petiole was left with the shield.

In tieing the bud, the best results were obtained when an opening for the bud was left. The work was done when there were no heavy rains; this practice may not be advisable in rainy weather.

An advantage that may be derived from using this method of tieing is that the growth of the bud is not hindered, as was observed at times with those covered completely for the same length of time. Also there is no need of unwrapping the bud until the pressure of the wrapping exerts a harmful effect on the stock.

SUMMARY OF CONCLUSION ON SHIELD BUDDING

1. The suitability of buds for use in propagation appeared to be determinable not by the flushes from which they are taken but by the form and development which they assume. First and second flushes generally furnished the largest number of good buds.

2. Buds well developed and plump and rounded in form gave the best success in budding. Sometimes the buds appeared to be loose at the outside, especially with some varieties where miniature leaflets may be seen, but even then they were hard within. The buds at their best seem to be ready to burst open.

3. Success in the cutting of the bud seemed to depend upon one's experience in the work. Buds were cut in varying lengths and thicknesses without apparent effect upon the result. Better results, however, were obtained by leaving a short piece of the petiole attached to the bud than by removing it entirely.

4. Wrapping the shield, leaving a small opening for the petiole and the bud, gave better success than complete covering when the work was performed in the dry season. A modification of this method may be advisable during the rainy season to stop the entrance of water through the wounds. Completely covering the bud may, at such times, give more satisfactory results, but more attention should be given to opening before pressure from the tape interferes with growth.

BARK GRAFTING

So far as the writer was able to ascertain from available literature, bark grafting has been tried only once as a means of propagating the avocado. Higgins (6) reports poor results obtained by using the method in Hawaii Agricultural Experiment Station. This method of asexual propagation has been tried with the mango (*Mangifera indica* L.), with some species of citrus, and with some other fruit trees with great success. It has proved to be well adapted to working over established trees. It has been described often as a very simple operation, requiring but little practice. While the method may not be considered as a better means of propagation than budding, yet there are conditions when bark grafting is preferable to budding. This is especially true in working over seedlings too old for the successful use of shield budding. It has been determined in the case of some fruit trees that the method of cutting back the tree severely

and budding the subsequent shoots does not give results in as short a time as does bark grafting. In an experiment carried out by the writer on the value of rough lemon (*Citrus limonia*), for stock purposes, in which kusaie lime (*C. aurantifolia* Sw.), Washington navel orange (*C. sinensis* Osbeck), and satsuma orange (*C. nobilis* var *unshiu*) were used for cions, very much better results were obtained by bark grafting than by budding. Shield buds inserted in the same tree produced a total length of only one fifth to one third of that produced from cions inserted by the bark grafting method. The same facts were observed with bark grafted mango seedlings with stems from five to eight centimeters in diameter. The belief that the union between the stock and the cion will be poor and hence result in a weak tree, was not supported by the experiments performed by the writer. The wounds were completely healed after two years. In the case of kusaie lime on rough lemon, trace of the union could hardly be noticed after one year and eight months.

OBJECTS

The main object of the work in bark grafting the avocado was to attempt to modify the method so as to adapt it to the peculiarities of the avocado. This involved experiments to determine the suitability of different flushes as cions for bark grafting. The value of different protecting materials to surround the cions and prevent their drying out before union has been effected, was also investigated. Likewise, it was desired to determine the effects, if any, of sun and shade on the newly grafted trees. Still another object was to find out whether bark grafting could be employed in three-year seedlings as well as in old avocado trees. In connection with the use of young seedlings as stocks a test was made to learn whether cutting them to single stumps would offer any advantage over leaving secondary branches to supply food to the stems and cions.

MATERIALS AND METHODS

Three year old avocado seedlings, 5 to 10 centimeters in diameter, planted in nursery rows 1.2 meters apart and one meter between the trees in the rows, were used. They represented two conditions as regards intensity of sunlight. One set composed of about 300 seedlings was growing in the open, and a set of 40 under the shade of some bancal trees (*Sarcocephalus orientalis* L.). The plants in the shaded set received some direct sunlight in the early part of the day but were protected from the intense heat and light during the rest of the day.

Branches of old established avocado trees were also used as stocks. Three different stages of development of the avocado branch, known as first, second, and third flush, were used as cions. Several protecting materials were tried in the experiment. Sphagnum moss, wax paper, fine sand, and sawdust were used at different times.

Description of the bark grafting.—With a sharp swivel saw the young tree was cut at a right angle with the stem at the desired height, 15 to 30 centimeters above the ground. The cut portion was made smooth with a sharp pruning knife. Using a budding knife a slit from five to eight centimeters long was made running downward perpendicular to the cut surface, just cutting the bark. A cion from 10 to 12 centimeters long was prepared by removing the leaves and cutting it flat on one side, leaving the other side round. Leaving about five centimeters at the upper end of the cion, a straight, clean, diagonal cut was

made to the lower end. The prepared cion was inserted with care between the slit bark and the wood with the flat surface of the former against the latter leaving one half of a centimeter of the cut surface of the cion not inserted. This was to make a better fitting of the cion with the wood. The cion when in position was at the center of the slit made on the bark. Heavy twine was used for tieing the stem to keep the cion in place and to hold it and the stock close together. Grafting wax of the composition of one part of beef tallow to two parts of resin and four parts of beeswax (all by weight) was used for covering the wound, including the cut at the upper part of the cion and the one-half cut near the surface of the stem. The protecting materials were then applied to prevent evaporation from the cions. Except when wax paper was used, the moisture preserving material was kept moist. The wrapping was prepared in the following manner: A piece of manila paper 30 by 45 centimeters was wrapped around the grafted stem in a funnel-shaped form, allowing about 15 centimeters of the paper funnel to project above the surface of the stem. The material, sphagnum moss, or fine sand or whatever was used, was moistened and placed snugly around the grafted stem and above it, entirely covering the free ends of the cions to about five centimeters from the free end of the funnel. Then the paper was pressed down thus completely covering the moisture-preserving material. Sometimes tieing with a piece of string wound around the funnel-shaped wrapping had to be resorted to, to keep the wrapping from bursting open.

After 14 days the paper covering was removed, leaving only a thin layer of the protecting material on the cut surface of the stem for protection against intense sunlight.

All the new shoots that came out below the cion were removed.

EXPERIMENTS AND RESULTS

Eighteen avocados planted in the open with stems from five to eight centimeters in diameter were bark grafted using the methods described above. Nine plants were cut down to 20 centimeters from the ground, leaving only bare single stems. Three of these were worked, using two first flush cions, placed opposite each other.

Three seedlings were worked using second flush cions and three trees were grafted with third flush branches.

Another set of experiments was run similar to the one described above, except, that instead of leaving only a single stem, a branch was left to supply food to the plant. The trees were cut from 10 to 30 centimeters above the ground. Those with branches left had to be cut higher than when they were sawed to single stems as the lowest branches were often placed at 30 to 45 centimeters above the ground.

In the two sets of experiments, sphagnum moss was used for protection. It was dipped in water, then pressed with the hands so that it would not be too wet. The operation was performed on August 23, 1922, and the protecting material removed, September 6, 1922. Two months later the results shown in Table V were obtained. At the time the results were obtained the cions were partly united with the stocks. Some had buds as long as five centimeters.

TABLE V.—*Showing results of selection of cions and methods of cutting stocks.*

Methods of cutting stocks.	Cions inserted.			Cions living.			Percentage of success.		
	First flush.	Second flush.	Third flush.	First flush.	Second flush.	Third flush.	First flush.	Second flush.	Third flush.
Stem reduced to a stump.....	6	6	6	5	6	4	83.33	100	66.66
Branches allowed to remain as support	6	6	6	5	5	4	83.33	83.33	66.66

Observations showed that the cions with buds that were well developed grew first and at a faster rate than the poorly developed buds which remained green showing no indication of growth. Some of the poorly developed buds fell off although the cion as a whole remained green. The cions, where the buds were full and plump, developed and opened 20 days after insertion.

The third flush cions made the poorest showing, the second the best, and the first the second best. On November 28, all of the eighteen grafted trees were found slightly wilting with conspicuous yellow rings at the lower portion of the cions near the trunk of the stock. In the course of a few days, the yellowish ring turned dark tan in color, similar to the color of the rotting stem. From this point the rot continued upward until the cions became black. Ten of the plants found thus diseased were cut below the lowest part of the earlier incision, excluding the part which seemed abnormal. The wound was covered with a paint of white lead and oil. The other eight trees were not touched. All of the 10 trees cut were examined and it was found that union between the stock and the cion was effected in every case. From the cut stems and cions, specimens were saved for examination for harmful organisms. They were taken to the Department of Pathology of this College where the causal organism was grown in pure culture. The disease was declared to be due to a *Diplodia*.

It is interesting to note that the trees left untouched were all killed, leaving greyish stems, which, when the bark was taken out, showed a black mass of mycelium covering the wood. Some of those with the stem cut were saved but three died back in a manner similar to those untouched.

To get more data on the subject of cutting the stock and with a view to finding out whether reducing the tree to a single stump has any advantage over leaving a branch or two for support, an experiment similar to the one just described was made. Twelve seedlings apparently under the same conditions were selected. Six were cut 20 centimeters above the ground, leaving only single stumps. The remaining six were cut at the same height, but each was provided with a branch from two to two and one-half centimeters in diameter. All of the seedlings were about five centimeters in diameter at the point of the cut. The cions used were all second flush, provided with buds, plump and well formed. In the operation the saw and knives used were disinfected with a one per cent solution of bichloride of mercury. The hands of the operator were also disinfected. The sphagnum moss used had been boiled for one-half hour and then cooled. In every case care was taken to minimize the probability of infection. Two cions were inserted in each tree. The operation was performed on November 29, 1922. All of the cions united and produced leaves.

Following the same precautions as described above with regard to infection, additional experiments were run on the suitability of the three different flushes for bud purposes. Nine seedlings of apparently the same condition were selected for the experiment. They were cut down to about 20 centimeters from the ground leaving only a single stem in every case. Three were grafted with the first flush cions, three with the second flush, and three with the third flush. Three cions were inserted at equal distances apart around the circumference of the stem. Sphagnum moss was used for wrapping. The cions selected had buds that were developed and almost ready to open.

All of the inserted cions grew. The first and second flush cions developed first while those of the third flush remained green for a long time without exhibiting very much activity. The second flush cions seemed more vigorous than the first flush, although they grew at about the same rate.

With a view to finding a wrapping material that would be cheaper than sphagnum moss, fine sand, sawdust, and wax paper were used. Using the same treatment, nine plants were grafted to second flush cions. Three were covered with a closed wax paper bag; three with moist fine sand; and three with moist sawdust. The sand and the sawdust used had been sterilized by boiling in water for half an hour. A duplicate set of the experiment was made. The results are given in Table VI.

TABLE VI.—*Showing results of different protecting materials.*

Series No.	Wrapping.	No. of buds put in.	No. of buds living.	Percentage of success.
First	Fine sand	12	8	66.66
	Sawdust	12	10	83.33
	Wax paper	12	10	83.33
Second	Fine sand	12	9	75.00
	Sawdust	12	10	83.33
	Wax paper	12	9	75.00

Some of the experiments here reported were carried out in the open and some were conducted in partial shade. It was observed that the grafted plants in partial shade were apparently more vigorous and healthy than those directly in the sun. To find out if there is any advantage of bark grafting under either condition, six plants, three from the shade and three from the direct sunlight, were bark grafted, using the same method in all cases.

After two months all of the 12 cions in the shade were living, and 10 out of 12 in the direct sunlight. The cions placed in shade were green and vigorous, some having buds that had grown to shoots 2.5 centimeters long. Those in the open were not so vigorous, and although the buds were developing, they seemed weak.

An examination of cions in the open showed that there were a few that were very much affected by the intense heat of the sun. A reddish ring could be seen at the lower end of the cion at the place where it came in contact with the wax which was melted and which undoubtedly was raising the temperature near the

surface of the stock. The following temperature readings were made on February 16 at 11:00 a. m.:

Open air in shade	32° C.
Average of ten readings on the top of the stock	47° C.
Inside the bark where a cion had been removed	44° C.
On top of stock covered with sand	51° C.

The reddish rings noted were similar to those found in cases of attack by *Diplodia.*

Eight branches of old trees about 10 centimeters in diameter and cut off at 60 centimeters from the main trunk were bark grafted. Four cions of the second flush were inserted in each branch and covered with sphagnum moss. A total of 32 cions were used: of these, eight died and the rest "took". The cions, although green, were not as vigorous as those placed in the three year seedlings.

DISCUSSION OF RESULTS

In the experiments with the value of the different flushes as cions, results show that the first and second flushes were better than the third. A duplication of the experiment using cions with better developed buds showed better results; further evidence of the desirable qualities of well developed buds. In every case the third flush cions did not prove as satisfactory as the first and second, and the second flush showed better vigor than the first. It appears probable that the first flush is not sufficiently mature for optimum results while the third flush has passed beyond the best condition. A similar result was obtained in the budding described in the first part of this paper.

Not very much evidence was obtained to show that cutting the tree to a single stump is any better than leaving a branch or two for the support of the plant, nor was it proven that the reverse is true. Experimental data on the subject prove that bark grafting of mango may be done, cutting the stock either way.

For protection from loss of moisture the sphagnum moss proved to be the best of the different materials tried. It was observed that where the wrapping material was kept snugly around the cions, less watering was necessary, the cions were better preserved, and better success was obtained. Observation showed that where the sphagnum moss was kept too moist cions deteriorated, while if the wrapping was kept too dry, the cions became dry also. Those covered with moss just moist,—not too dry nor too wet—retained their green color and seemed to be as fresh as when first severed from the tree. This condition may be due to the better conserving of the moisture of the cion at its normal content until union takes place and the cion gets its support from the stock.

Sawdust gave the second largest number of living buds. If this material is used it would be advisable to wash the cions after removing the wrapping, as otherwise, the dust may cover the buds. The low price at which sawdust may be obtained—for almost nothing—gives it an advantage as a substitute for moss. If it is used, it should be moistened twice before removing the wrapping.

Wax paper proved to be especially good during the wet season when less evaporation occurs on the cions and when other wrappings tend to absorb too much water causing deterioration of the cions. If used in dry hot weather, the heat and dryness result in excessive loss of moisture from the cions exposed.

Sand proved to be the poorest protection material. Measurement of temperature showed a high increase in those wrapped in sand. It is not improbable that this may be the cause of a large percentage of mortality in cions where sand is used for wrapping.

Sterilizing the wrapping materials and disinfecting tools used in grafting proved to be an efficient means of eliminating the ravages of *Diplodia*. There is extra expense in using sterilized tools but it undoubtedly is economy as there is a large amount saved in terms of living grafted plants.

Results of experiments showed that plants grafted under partial shade gave a higher percentage of living cions than those grafted in direct sunlight. This is to be expected as the newly inserted cions are delicate and not in a condition to stand rapid transpiration and too intense sunlight. It may be that those attacked by *Diplodia* were first devitalized because of too much heat and then the organisms came in. During the rainy or cloudy days shade may be dispensed with, but if grafting is done during hot dry weather it is advisable to put temporary shade over the plants, at least up to the time when the wound heals over. Whitewashing the plants was not practiced, but for protection from sun scald it is recommended that some such protection of the stocks be used.

Using old branches as stocks showed that a fairly good result may be obtained, but better success was obtained from younger seedlings. The cions did not develop as fast in the old stocks as in the seedlings.

SUMMARY OF CONCLUSIONS ON BARK GRAFTING

From the foregoing data, the following summary may be made:

1. Three-year old avocado seedlings as well as branches of old trees may be bark grafted. Better success was obtained by using the younger stocks. The stocks are ready for grafting if the bark slips.

2. Three-year old avocado seedlings may be cut to a stem 20 centimeters above the ground or a branch may be left with it to serve as support.

3. Bark grafting is better done in partial shade than in the open, too much heat from the sun tends to lower the vitality of the cions and finally causes them to wilt.

4. Sphagnum moss proved to be the best protecting material, with sawdust second. Wax paper is especially recommended for the wet season. Sand proved to be the poorest material tried. It is necessary to keep the protecting material properly moistened, except with wax paper wrapping.

5. First and second flush cions proved much better than the third flush. Second flush cions were better than first. Well developed buds proved to be very essential.

CLEFT GRAFTING

Working over an established tree to a desired variety has sometimes been accomplished by what is known as cleft grafting. Manning of California (7) described a method of "top-working" the old avocado tree. For his tools he named the following: "a wedge made of some hard wood eight to ten inches in length and one inch in diameter, a pruning saw, butcher's cleaver, a hammer, a pot of grafting wax, some contrivance for keeping the wax warm (I use a lamp in a coal oil can), a paint brush and a roll of budding cloth . . ." "Second growth" wood with buds well-formed and plump were used as cions. Two to

four cions were inserted in each old branch cut down. The technique Manning used for grafting is quoted in full:

> Having selected a point at which your final cut is to be made, go a foot or two above and saw off the heavy top. This is a precautionary method to prevent splitting. The top being removed, cut squarely across at right angles to the long axis of the limb at your selected point. Next with a sharp knife smooth the face of the stump, removing the velvety surface left by the saw. Then place the cleaver across the middle of the stump and split it with several sharp strokes from the hammer, remove the cleaver and insert the wedge, pounding it in until the crack across the face of the stump is at least twice the width of the graft to be used. Unless the stump is split for a considerable distance the pressure on the grafts will be too great when the wedge is removed. You are now ready to prepare your graft.
>
> Select your graft stick, as a rule using the heavier wood in the larger stump. Cut the lower end of the grafts in such a manner as to form a wedge approximately one inch in length. The sloping sides of this wedge must be perfectly flat and smooth. Correct any concavities or convexities which may exist. The length of the graft is unimportant, but it should possess two or three good healthy buds. The top of the graft is cut squarely across, leaving a flat smooth surface. The grafts now being prepared, insert the wedged ends, one on either side of the split in the surface of the stump, carefully remove the wedge until the grafts are slightly pinched but easily movable. Now adjust the grafts, outer side of the graft is in contact with the cambium of the stump. This being done remove the wedge and the pressure will hold the grafts firmly in place.
>
> A crack of considerable width now remains across the face of the stump. This is filled in with paper, cloth, avocado leaves, or anything else which may be at hand, the idea being to prevent the hot wax from running away when later it is applied. Next apply a bandage of budding cloth about one inch wide from the top of the stump to the lower limit of the split in its sides. Now with a paint brush apply a generous coating of hot wax to the face of the stump, making sure that the outer edges and points of contact between the grafts and stump are well covered. Owing to the thickness of the bark on the stump the grafts will set slightly in, leaving a space between the bandage and the graft, this space is filled with a plug of soft wax and painted over with hot wax. It is well to reinforce the bandage where it covers the split with a coat of the wax. Cover the upper ends of the graft with a thick coat of paint, it is more adhesive than the wax, which is sometimes used. Protect the grafts from the sun by wrapping newspaper about the ends of the stumps. If possible always leave a few branches on the grafted tree for two months to aid in carrying on the circulation. The trunk of the tree and the large branches are protected from the sun-burn by means of the application of several coats of white-wash.

Supporting the grafts is recommended. Very good results have been reported from using the method described above.

OBJECTS

The experiments in cleft grafting undertaken by the writer of this paper were intended to determine the adaptability of the method for use on stocks rather old for shield budding but a little too small for bark grafting. A further object was to gather more data on the suitability of the three different flushes for use as cions and on the value of wrapping materials in conserving of moisture in the cions.

MATERIALS AND METHODS

The seedlings used for stocks in this experiment were from one and a half to two years old. The stems varied in size from two to four centimeters in diameter and almost all were brownish in color. According to best results obtained in shield budding and in bark grafting, the seedlings were too advanced in development for the first method and rather small for the second. They were all grown in the open in nursery rows set one meter apart.

The cions used were first, second, and third flushes. Only those with well developed buds were chosen. Sphagnum moss, wax paper, sawdust, and fine sand were used for protection. Manila paper was used to hold the protecting material close to the cion and prevent the rapid escape of moisture.

Description of cleft grafting.—Using the flush desired, the cion was cut to about 10 centimeters, the petiole removed a short distance from the stem and a wedge was made starting the cut from four to five centimeters from the upper end of the cion. The cut was made straight and clean. The stock was then cut at right angles with the stem about 15 centimeters to 30 centimeters above the ground. A split was made with a sharp budding knife through the center of the stem and running downward about six millimeters shorter than the length of the wedge of the cion. The cion was then inserted in the cut leaving a short part of the wedge out to insure a better fit of the cion in the stock. The two cambium layers were made to come in close contact. The cambium of the thicker side of the wedge was placed in contact with the cambium of the stock, thus giving more pressure at this side where union must begin. With a piece of budding tape, one centimeter in width, the cion and stock thus put together were tied from the lower end of the cut upward, covering the whole wound. Any additional wound in the cion not covered with the tape was covered with grafting wax for protection against the loss of moisture and the entrance of harmful organisms. Beginning below the wound a piece of manila paper about 20 by 25 centimeters square was wrapped about the stock in a funnel-shape and inclosing the cion in the middle. Then the moist protecting material was placed in the funnel-shaped paper bag, snugly covering the whole cion. The upper end of the paper was pressed down closing the bag. It was not found necessary to renew the supply of moisture in the moss but with sand and sawdust it was necessary to open the top of the paper covering and add more moisture once or twice. The covering was removed after two or three weeks.

EXPERIMENTS AND RESULTS

Thirty seedlings of apparently the same condition were cleft grafted. Ten were grafted to first flush cions, 10 to second flush, and 10 to third flush. They were covered with moist sphagnum moss. The operation was performed on September 30, 1922. They were opened on October 17. All of the second flush cions were green; one of the first flush and four from the third flush died. On October 30, one was dead from the second flush; two from the first, and one from the third, leaving alive nine in the second, seven in the first, and five in the third. These living cions continued to develop with the second flush cions leading in vigor and growth, the first flush coming next, and the third scarcely developing, although green and fresh in appearance. On December 3, some of the cions were turning yellowish and exhibited an unhealthy appearance. Two weeks

later most of them were wilted, although examination showed that there was union. On December 20 all were dead. Specimens were brought to the Department of Pathology for examination and they were found to be infected by *Diplodia*.

Twenty-four seedlings were cleft grafted to second flush cions on October 23, 1922. Of these, six were covered with moss, six with wax paper bag, six with fine sand, and six with sawdust. The moss, sand, and sawdust used had been boiled in water for half an hour and were applied moist. The covering was removed November 3, and it was found that all the cions covered with moss, three in wax paper, four in sawdust, and two in sand, were living. The particles of sawdust and sand adhering to the buds were removed. On December 3, five of those wrapped in moss, two in wax paper, two in sawdust, and one in sand were green and developing.

The experiment was duplicated using 10 plants for each treatment. Results obtained were similar to the first, nine in moss, seven in sawdust, five in sand, and five in wax paper living.

DISCUSSION OF RESULTS

In vigor and number of living buds, the second flush cions proved to be superior to either the first or the third flushes. The buds of the second flush opened earlier and seemed to be more resistant to adverse conditions than the first and third. The advantage of using cions with well developed buds again seemed apparent. Buds of poorer qualities were slowest in developing.

Experiments on the value of different materials for protection showed that sphagnum moss was the best of those tried. This is the same result that was found in bark grafting the avocado. It is not improbable that this may be due partly to the spongy character of the moss. Sawdust was second to sphagnum moss as a protecting material. With sawdust, two cions out of six inserted in one set and seven out of ten in the second lived. One objection to using either sawdust or sand is that they become dry readily, necessitating frequent watering, hence do not maintain as uniform a distribution of the moisture as the moss. Wax paper, as with bark grafting, did not show good results. The rise of temperature inside the bag was very much higher than with the moss; the heat becoming too intense, it resulted in injury to the cions. The experiment was performed during dry weather; results might be different if the wax paper was used during cool rainy weather.

SUMMARY OF CONCLUSIONS ON CLEFT GRAFTING

1. In cleft grafting two-year old seedlings, second flush cions of avocados proved superior to either first or third flushes. First flush came next, the third flush proved to be the poorest. Cions with buds well developed are to be preferred to those with poorer buds.

2. Of the protecting materials tried, sphagnum moss proved to be the best, with sawdust second, and wax paper and sand third.

OTHER EXPERIMENTS IN PROGRESS

PROPAGATION BY CUTTINGS

The suitability of growing the avocado by cuttings is being determined. Branches of various ages are placed in different growing media. Ringing the

branches and allowing them to callous before planting them is being tried. Branches treated with ether and varying strength of potassium permanganate solution are under observation for effects on production of roots. Bottom heat is also being tried for its effects.

MARCOTTAGE

Various experiments on propagating the avocado by marcottage are in progress. The effects of season, different ages of wood, various kinds of media, and different treatments before ringed parts are covered with the rooting media are all being tried.

ACKNOWLEDGMENT

The writer is greatly indebted to Professor J. E. Higgins, Head of the Department of Agronomy, for valuable suggestions and criticisms made during the progress of the work and in the presentation of this paper.

ADDITIONAL NOTES

The following experiments were performed after the foregoing work had been presented to the Committee on Graduate Studies.

One hundred and seventy avocado seedlings six months old and planted in nursery rows one meter between the rows and one-half meter in the rows were budded. The stocks were very vigorous and the bark slipped readily. The budwood used was young, but the buds were well formed. Of the plants operated upon 158 grew successfully.

Several methods of forcing the bud into growth were used. Of these, partial removal of the crown gave the best results. The process consisted in removing a short portion of the terminal or terminals two weeks after budding. New sprouts, coming from the stock above and below the bud were rubbed off leaving only the inserted bud to grow. The growing shoot was tied, when necessary, to the old trunk as a support. When the new growth became sufficiently mature to require no further support the stock was removed just above the point of union and the wound was covered with asphalt-kerosene or other protective material.

Of several dressing compounds used to protect the wound from unnecessary loss of moisture and the entrance of harmful organisms, that composed of one part of asphaltum grade D and one part of kerosene oil proved the best. Paraffine of a high melting point when heated slightly and brushed on to the wound was also found good. White lead and linseed oil although mixed very thick did not stay long enough to enable the bark to cover the wound while the wood was fresh. The paint dried in about a month and fell off leaving the wound exposed. To use this successfully, painting was done at intervals of a few weeks.

BARK GRAFTING

In the former experiments with bark grafting the harmful effects of intense sunlight were noted. Grafting wax of different composition, but plastic enough for manipulation by the hand, was found to be low in melting point and frequently flowed down the stock. To remedy this, warmed paraffin of high melting point applied to the wound was used. A temporary shade of light material over the plants was found helpful. Forty-seven avocado plants, out of 50, three years old, were successfully bark grafted.

It was found possible to bark graft plants formerly unsuccessfully operated upon for bark grafting. In such cases the trunks were sawed off about 10 to 15 centimeters below the previous cut. Whether the first or a later trial, new sprouts on the stock must be removed.

Gradual removal of sphagnum moss around the grafts proved better than when all the protective material was removed at once. The moss was loosened and made thinner and thinner until the whole was removed, when the grafts were 10 to 20 centimeters tall.

Budded and grafted avocado plants were successfully transplanted by pruning them heavily, observing extra care in balling, and putting them at once under shade till new growth was started. A constant and adequate supply of water was found important.

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ON ALANGIUM LONGIFLORUM MERR. (MALATAPÁI): A PROMISING WILD TREE OF MOUNT MAQUILING[1]

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WITH ONE PLATE

The varieties of wild food plants in the Philippine Islands are numerous. Long before the arrival of the Spaniards, the inhabitants depended to a considerable degree upon plants for food. Many temperate, tropical, and subtropical food plants have been introduced since 1521; many of these are well naturalized and are of great value. But what have we done with regard to the cultivation of our wild food plants?

Barrett (1) in 1913 published a list of a few fruits of economic importance. De Leon (2) three years later described seventeen species of the commonest fruits of the Philippines. Wester (3) of the Bureau of Agriculture one year later brought to our attention some promising fruit trees. Villanueva (4) of this College in 1920 reported on twenty-seven kinds of edible fruits common in Laguna and Cavite provinces. The last to offer information on wild food plants is Brown (5) in 1921. But the list of plants is far from being complete.

It is the purpose of this paper to note the possibilities, both as a food plant and as an ornamental, of a wild tree found on Mount Maquiling. If this tree (malatapái) were put under cultivation the size and the quality of its fruits would doubtless be improved. Also, a pleasing ornamental for lawns, parks, and gardens would be secured, as the flowers are fragrant, showy, and abundant. So far as known, the attention of those interested in horticulture and floriculture has never been called to this species.

DESCRIPTION OF THE PLANT

The synonyms of *Alangium longiflorum* Merr. are *Alangium lamarkii* F.—Vill. and *Alangium octopetalum* Vidal. In the Philippines the plant is known in the vernacular as apitan, bunglas, busahin, guntapái, lumuluas, magatapái, malakapái, and malatapái.

Malatapái is a small deciduous tree[2] about five meters tall, but may attain a height of ten meters. Branches are rather pendant, grayish-brown, smooth; juvenile ones, softly pubescent with short pale-brown hairs. Leaves fall off during the dry season and begin to appear after blooming. They are oblong to oblong-ovate, rather thin, pubescent on the veins and veinlets at the lower surface when young, glabrous when mature, 10 to 15 cm. long, and 4 to 7 cm. wide, entire, the apex acuminate; petioles short, 5 to 8 cm. long, pubescent when young, smooth when mature.

The flowers (see Plate 1, fig. 2) are borne in April while the tree is defoliated. Often a second crop of flowers appear in June by which time the April flowers have become fruits. The flowers are white, fragrant, axillary, 1 to 4

[1] Experiment Station contribution, No. 281.
[2] For complete description, see Merrill (5).

in each axil, the pedicels densely pubescent, stout, 2 to 4 mm. long. Petals are more or less adnate when the flowers are young, enlarged at the base and at the top, but narrowed at the middle; free when mature, 5, rarely 4 or 6, 3 to 4 cm. in length. Calyx obconic, 4 to 5 mm. long, 4 mm. wide, 5-toothed. Stamens 16 or 17, rarely 15 or 18, as long as the petals, white, spreading; filaments villous in the lower half. Style white, as long as the stamens; stigma globose.

The fruits (see Plate 1, fig. 1) ripen in June. They are globose, red in color, 1¾ to 2 cm. long, and 2 to 2 ¾ cm. wide. The pericarp (see Plate 1, fig. 3) is distinctly differentiated into three layers. The exocarp is whitish, 1 to 1 ½ mm. thick, the epidermis red. The mesocarp, the middle layer, is whitish, the inner tissue somewhat pink, 1 ½ to 2 ½ mm. thick. This layer contains a substance with a rather bitter constituent, the chemical nature of which is unknown. The endocarp (the inner layer) is the fleshy pulp. It is juicy, crimson in color, and is easily exposed and removed by holding the fruit with two fingers, splitting from the basal portion; wider at the base, 4 mm. thick, and very thin at the sides, about ¼ to 1 mm. thick. The pulp is edible, a little sweet when overripe; the flavor suggests ripe mulberry fruit. The fruit is fairly good for eating raw and can be used for jelly and jam.

The seed (see Plate 1, fig. 4) is ellipsoidal with two distinct coats. The outer coat (the stone) is brown in color, brittle, ½ to 1 mm. thick, with the basal and the stylar ends thicker. The inner coat is papery, faint yellow in color, and adheres to the endosperm when the stone is removed.

DISTRIBUTION

The species is found on slopes along the Molawin Creek and along the streams at low and medium elevations. It has been reported from Luzon (Cagayan, Ilocos Norte, Laguna, Tayabas, Camarines, and Sorsogon provinces), Palawan, Leyte, and Mindanao. It is endemic to the Philippines (6).

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ILLUSTRATIONS

Plate I

Alangium longiflorum Merr.

Figure 1. The fruits. Natural size.

Figure 2. The young leaves and flowers. Natural size.

Figure 3. Longitudinal section of a fruit showing the three distinct layers of the pericarp: exocarp, ex.; mesocarp, me.; endocarp, en.; and also the two coats of the seed: outer coat (stone) s.; inner coat, ic. Natural size.

Figure 4. The seed. Natural size.

PLATE I.

REFRIGERATION OF MANGO[1]

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INTRODUCTION

In recent years refrigeration has been applied to a wide range of food products as a means of storage for a more equable distribution of foodstuffs throughout the year and for the transportation of such to distant markets. All kinds of commercial fruit of the temperate zone have been the subject of experimentation in refrigeration and the adaptability of each to cold storage preservation is well known. Apples, for example, are kept in good condition throughout the entire year and have been kept for two years. Strawberries, raspberries, and some of the other berries can be safely preserved only a very few days. Likewise the temperatures best adapted for preservation have been worked out in the case of all of the temperate zone fruits. Also the best degrees of maturity of the fruit have been determined.

In the case of the tropical fruits the situation is quite different. With these fruits, except the banana, there has been comparatively little systematic experimenting in refrigeration. The large banana shipping companies on the Atlantic regularly use cooling systems to retard the ripening of bananas in transit, in which case the major portion of the cargo space is occupied by bananas and is cooled by the application of the principles of refrigeration. The banana however is a striking example of the limitations of the degree of refrigeration which is possible in some fruits. Bananas are not cooled much below 55° Fahrenheit (12.77° C.). If the temperature falls much lower than this the fruit turns black and will not ripen.

In considering refrigeration as a means of preserving fruit, it must be remembered that the fruit is a living organism with a definite life cycle. The life processes proceed more slowly in cold temperatures than in warm. This biological principle is well illustrated in the case of certain insects which pass through a life cycle in a few weeks at sea level in the tropics, while at high altitudes several months are required for the same species to complete the cycle. In refrigeration the life processes of fruit are retarded. If, however, the refrigeration is continued too long or the temperatures are lower than the organism can endure, the life is destroyed and ripening becomes impossible.

About the years 1906 to 1908 the senior author conducted some experiments in the shipping of pineapples, papayas, and avocados in refrigeration from Honolulu to San Francisco and other American markets.[2] Avocados and papayas were landed in good condition in San Francisco, Seattle, Tacoma, and Vancouver, B.C. Pineapples and avocados arrived in good condition in Chicago. Some further tests were made of refrigeration applied to the mango and avocado in Honolulu.

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1 Experiment Station contribution, No. 282.

2 Higgins, J. E. Marketing Hawaiian fruits. Hawaii Agricultural Experiment Station Bulletin 14. 1907.
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OBJECTS OF THE WORK

The purpose of the present work was to make preliminary trials which might indicate the most promising temperatures and conditions for more extensive experiments which should be conducted during the height of the mango season when fruits are abundant and comparatively free from disease. It was desired to learn what temperatures may be endured without injury and over how long a period the fruits may be exposed to such refrigeration, without destroying the life of the fruit and thus making it impossible for it to ripen even after being removed to warm air.

TIME AND PLACE OF THE WORK

The fruit was harvested from the trees at the College of Agriculture on August 6, packed on August 7 and 8, and placed in refrigeration on the morning of August 9. The last of the fruit was removed from refrigeration on September 20. These experiments were greatly facilitated by the very hearty co-operation of Mr. Andrés Soriano, General Manager of the San Miguel Brewery, Manila, who voluntarily offered free storage space and complete records of readings of temperatures.

MATERIALS AND METHODS

THE FRUIT

The mangoes included 331 of the Carabao and 185 of the Pico varieties. The Carabao is the leading market variety in the Philippines and one which has made the "Manila" or "Philippine" mango famous around the world. It is of medium to large size, variable in shape, light orange-yellow[3] rind of very attractive appearance, and with flavor, texture and aroma that place it among the best mangoes found anywhere in the tropics. The Pico is of less importance but is frequently found in local markets. It has a higher coloring than the Carabao, but is extremely subject to mango anthracnose[4], a fungus disease which causes large blackened areas on the surface; the disease also penetrates the flesh. The same fungus destroys the flowers and young foliage if the weather conditions are favorable for its growth and is the most important cause for the failure of the mango in regions where the rainfall is heavy during the season of flowering. Besides being subject to anthracnose the Pico is so inferior in flavor and texture to the Carabao that it is scarcely to be considered in the development of the mango industry.

The month of August being in the rainy season it is difficult to find mangoes free from anthracnose to which most varieties are very susceptible. During the usual mango season of Luzon, ranging from March to June, the weather is dry, the fungus is not prevalent and the fruits are perfectly clean and yellow. But rain and humid atmosphere are favorable for the development of the fungus and nearly all the fruit in the present experiments were more or less affected.

The fruits were wrapped in paper, packed with their stem ends down, in single layer crates, well ventilated and provided with a cushion of excelsior beneath and above the fruit. Each box contained from 30 to 35 fruits. The fruits when harvested were mature but nearly all were green in color, only a few

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[3] Ridgway, "Color Standards and Color Nomenclature." Washington, D.C.
[4] Caused by *Colletotrichum gloeosporioides* Penz.

showing traces of yellow. This is the condition in which the Carabao mango is usually harvested for marketing. Such fruit ripens well, acquiring a good color and excellent flavor.

THE REFRIGERATION

The San Miguel Brewery made space available in four different rooms designated Rooms 4, 1, 7, and E in which the temperatures were intended to be held at approximately 36° F. (2.22° C.), 40° F. (4.44° C.), 45° F. (7.22° C.), and 50° F. (10° C.) respectively[5].

One box was retained at the College at ordinary room temperatures to observe the time required for ripening and for decay without refrigeration. The fruits in this latter crate were examined daily until they were no longer suitable for food. Some of the fruits which were placed in the refrigeration on August 9 were examined on August 26, seventeen days after they had been subjected to cold storage. Notes were made of their condition at this time and representative samples of each variety from each room were taken out on August 27 to afford opportunity to observe the progress of ripening after refrigeration. The fruits remaining in refrigeration were again examined on September 13, thirty-five days after being placed in storage and representative specimens were removed on the thirty-sixth day to observe the effect of the refrigeration upon the further progress of ripening. The last of the fruits were removed from the cold storage on September 20.

In Room 4, from August 9 to September 2, the readings of temperatures taken at 8:00 a. m., 12:00 noon, and 4:00 p. m. daily by the employees of the refrigeration plant, showed a very uniform temperature, the maximum during this period being 36° F. (2.22° C.) and the minimum 35° F. (1.66° C.), the latter being recorded only twice and on the first day of storage. After September 2, the temperatures in this room were a little less uniform, the maximum temperature recorded being 42° F. (5.55° C.) and the minimum, 36° F. (2.22° C.). With the exception of four readings, the temperatures were not above 40° F. (4.44° C.) and showed a mean temperature of 37° F. (2.77° C.) from September 2 to 20. Room 1 showed recorded temperatures of 40° F. (4.44° C.) continuously throughout the period of the experiment with the exception of three readings which were 41° F. (5° C.) and one reading of 42° F. (5.55° C.). Because of an unavoidable accident the experiments in room 7 had to be discontinued, thus affording no data concerning the effects of refrigeration at 45° F. (7.22° C.).

Room E showed a reading of 50° F. (10° C.) throughout the entire period in which the mangoes were stored therein. Experiments in this room were discontinued after August 30.

RESULTS OF EXPERIMENTS

RIPENING OF NON-REFRIGERATED FRUIT

The thirteen fruits of the Carabao variety which were held at the College for storage at ordinary room temperatures were examined on August 8, 11, 13, 15, and 18 being 2, 5, 7, 9, and 12 days, respectively, from the date of harvesting. Two days after harvesting there were a few fruits with light shades of yellow color at the ends; otherwise all were green and all were hard. Five days after gathering, five of the fruits were bright yellow in color, seven with a lighter

[5] The Fahrenheit scale is used at this storage plant and most of the data on refrigeration of fruits are given in degrees Fahrenheit.

shade of yellow and one had decayed. Two days later or seven days from harvesting, five fruits were rotting, five more fully ripe and two still a greenish yellow. Nine days from harvesting, five fruits remained in marketable condition. Three days later or twelve days after being taken from the tree all were decayed and unfit for use. Briefly, losses due to decay had begun five days after harvesting and involved 41 per cent of the fruit seven days after harvesting, and the entire lot after twelve days.

In the case of the Pico variety, ripening and decay proceeded more rapidly. Two days after harvesting, the fruits were yellowing. At five days, two out of eight had decayed, at seven days only four remained, and at nine days only one could be considered fit for food. The rapidity of the breaking down process in both varieties, particularly in the Pico, was increased by the presence of anthracnose.

REFRIGERATED FRUIT

The condition of the fruits in refrigeration on August 26 after seventeen days in storage is indicated in Table I. The term "sound" as here used is not intended to indicate perfect and unblemished fruits but rather refers to those that had not decayed in refrigeration. As stated above, many were not free from anthracnose when harvested.

DEVELOPMENTS AFTER REFRIGERATION FOR EIGHTEEN DAYS

As shown in Table I, on August 27, a number of fruits were taken from the boxes in each refrigerated compartment and were brought to Los Baños for the purpose of observing their condition after being exposed to the warm temperatures that prevail in the Philippines. Examination to note developments began on August 28 and continued daily until the fruits were no longer suitable for food. The records of conditions and the progress of ripening and decay in each lot are here presented.

Refrigeration at 36° F. (2.22° C.)—(a) Carabao variety. The fruits that had been in Room 4 at a rather uniform refrigeration, approximating 36° F. (2.22° C.), were found to be green and rather firm one day after exposure to tropical temperature, yielding very slightly to the touch. One day later, coloring was apparent and in three to six days all the fruits ripened. Those not affected with anthracnose developed a perfectly natural color and were normal in appearance, texture, and flavor. When compared with the fruit ripened without refrigeration no difference was noted in the flavor. In those fruits which were affected with anthracnose, the disease developed rapidly in the warm atmosphere. (*b*) *Pico variety.* Two days after exposure these fruits were still fairly firm and were coloring normally except where diseased. The indications were that the fruits were not in any way injured by refrigeration, but as this variety is very subject to anthracnose the fruits broke down rapidly after removal from refrigeration.

Refrigeration at 40° F. (4.44° C.) (a) Carabao variety. One day after refrigeration the fruits were still green but yielded slightly to the touch. All the fruits were infected with anthracnose which progressed rapidly. No injury from refrigeration could be detected and in areas not involved in fungus attack the coloring was normal and the flavor not impaired. The preservation appeared to be far inferior to that afforded by 36° F. (2.22° C.).

Refrigeration at 50° F. (10° C.). (a) Carabao variety. This fruit, although not marketable because of the shriveled condition referred to in Table I and the progress of disease, was held for several days to observe the coloring. A few fruits colored fairly well. The flavor was not normal in any of the fruits that had been held at 50° F. (10° C.). After the first examination the experiments in this room were discontinued because of the unsatisfactory results in preservation and in ripening.

REFRIGERATION FOR THIRTY-FIVE DAYS

On September 13 after the refrigeration experiments had been running for thirty-five days another examination was made of the fruits remaining. The results are indicated in Table II.

DEVELOPMENT AFTER REFRIGERATION FOR THIRTY-SIX DAYS

The fruits for ripening were taken out on September 14, after thirty-six days of storage, and examinations for ripening began on September 15.

Refrigeration at 36° F. (2.22° C.) (a) Carabao. Areas of dull steel-gray became evident in all fruits, none of them ripened satisfactorily. (*b*) *Pico.* Results were the same as in Carabao, but Pico decayed more rapidly.

Refrigeration at 40° F. (4.44° C.) (a) Carabao. These showed the same gray discoloration as those from the room at 36° F. (2.22° C.) but to a less degree. None of them ripened and colored satisfactorily. The flesh softened but was light in color and too acid. (*b*) *Pico.* None (see Table II).

REFRIGERATION FOR SIX WEEKS

As the results in ripening after refrigeration for thirty-six days were in no case satisfactory, all the remaining fruits were removed from Cold Storage on September 20, or just 42 days after being subjected to the cold. The fruits were all examined daily. The results confirmed those recorded for the fruit that was thirty-six days in refrigeration so it is therefore unnecessary to go into detail, again. All the fruit was more or less affected by the cold and none ripened satisfactorily.

DISCUSSION OF RESULTS

THE FRUIT

It will be recalled that the fruits used in these experiments were all very much alike in the degree of maturity except that a few had begun to show very slight loss of green color and the beginning of yellowing while the others were wholly green. All were hard. Since it has been demonstrated that fruit in this condition of maturity can be subjected to a temperature of 36° F. (2.22°C.) for 18 days or more without injury or interference with the final ripening process, it is probable that fruit of such degree of maturity is the most suitable for refrigeration. However, it is not impossible that the fruit slightly more advanced in the ripening process might be capable of enduring longer exposure to the cold. But the general experience with refrigeration of fruits goes to show that after the ripening process has become at all advanced it is difficult to hold the fruit for a long time in any refrigeration. In further experiments it would be desirable to test the effects of placing the fruit in Cold Storage immediately after harvesting.

Future experiments in the refrigeration of Philippine mangoes should be conducted if possible during the dry season when mangoes are abundant and when they are much less seriously attacked by anthracnose.

The Carabao variety is so far superior to all other varieties at present grown commercially in the Philippines and is so much less subject to anthracnose that it is hardly worth while to consider the other common varieties in future experiments. Furthermore, so far as export is concerned, the reputation of the Philippine mangoes should be maintained by shipping only the Carabao variety.

TEMPERATURES AND PERIOD OF EXPOSURE

The results of the experiments in room E with a temperature of 50° F. (10°C.) were wholly unsatisfactory. The fruits were so badly shriveled as to be unmarketable and many decayed while in storage. The explanation of the shriveling lies in the fact that warm air has a greater capacity for moisture than cold air and fruits stored at 50° F. (10° C.) will give up a large amount of their water to the surrounding air unless this is already near the saturation point. If the air contains a large amount of moisture and also is warm the conditions are favorable for the development of the organisms of decay. Air that is reduced to a low temperature is not capable of holding so much humidity and hence takes up less from the fruit stored in it. The higher the temperature of the air the greater will be its capacity for holding moisture. Because of the shriveling and the decay of the fruit, a temperature of 50° F. (10° C.) can not be recommended.

It is regrettable that it became necessary to discontinue the experiments in a temperature of 45° F. (7.22° C.) and no data are available for such refrigeration. However, considering the excellent results for short periods in 36° F. (2.22° C.) and the wholly unsatisfactory results at 50° F. (10° C.), a temperature of 45° F. (7.22° C.) is not to be considered, at most, promising.

In room 1 the records of 40° F. (4.44° C.) were quite uniform. Fruit removed from this room after eighteen days was not satisfactory chiefly because of the progress of fungus attack. It is possible that the results would be quite different with uninfected fruit ripening in the dry season. It also appeared that fruit held at this temperature for eighteen days ripened more quickly after removal than the mangoes kept at a lower temperature. After thirty-six days of refrigeration the gray discoloration appeared and was due apparently to too long exposure to cold. It does not appear probable, therefore, that Philippine mangoes can be held at 40° F. (4.44° C.) for five weeks without injury. Further experiments should be conducted with this degree of refrigeration, making close observation of the fruits at very frequent intervals after two weeks.

In room 4 where the temperature was held rather closely to the desired 36° F. (2.22° C.) the condition of the fruit after eighteen days refrigeration and the manner in which it ripened after removal indicated that this is a favorable degree of refrigeration for short periods. The fruit was in no way injured by the cold and in flavor, texture, and coloring was as good as that which had not been in storage. The results of the first examination were so favorable that it was not considered necessary to make a trip to Manila to examine the fruit again until it had been in storage for 35 days. At this time injury of the fruit was apparent. It had evidently been exposed longer than it could safely endure this degree of refrigeration.

The indications of this experiment are that sound, green and hard but fully matured Carabao mangoes may be expected to retain their normal conditions in such refrigeration for a period of eighteen days or more, but not so long as thirty-five days. It is probable that the period may be considerably more than eighteen days. But even basing calculations on eighteen days as the limit, the

time would be sufficient to reach all the important ports of Asia from Yokohama to Singapore and also ports on steamship routes to the East Indies. It is admitted that the mangoes of the Philippines are far superior to those of Malay and Java and would probably sell readily there, although the greatest opportunity for marketing these fresh fruits would be in Japan and China. Steamers on these runs are now equipped with space that can be refrigerated. If the period of refrigeration can safely be extended to one month it would be sufficient for the transportation of the fruit to America.

TABLE I.—*Indication of results in boxes opened on August 26, 1924, after 17 days in refrigeration.*

Box No.	No. of sound fruits. [a]	No. of unsound fruits.	No. of fruits taken out (Aug. 27.)	Room.	Intended approximate temperature.	Remarks.
Carabao						
16	22	2	4	4	36°F. (2.22°C.)	Sound fruits, green and firm. No indication of ripening process advancing.
15	28	2	5	1	40°F. (4.44°C.)	Fruits firm, green, with very slight yellow appearing; no indication of shriveling, the 2 unsound fruits attacked by anthracnose.
2, 3 and 4	34	50	30	E	50°F. (10°C.)	The fruits shriveled, some showing yellowish green color, but not marketable.
Pico						
16	9	1	4	4	36°F. (2.22°C.)	Fruits firm, except one unsound.
3 and 5	0	45		E	50°F. (10°C.)	Fruits shriveled, greenish and yellowish in color, but not marketable; almost all decayed.

a As to use of term "sound" see page 446.

TABLE II.—*Indication of results on September 13, 1924, 35 days after refrigeration.*

Box No.	No. of sound fruits. [a]	No. of unsound fruits.	No. of fruits taken out (Sept. 14.)	Room.	Intended approximate temperature.	Remarks.
Carabao						
16	18	2	5	4	36°F. (2.22°C.)	Most of the fruits still green, some very slightly yellow and softening. Areas of dull grey color found on some fruits.
15	20	2	5	1	40°F. (4.44°C.)	The color of the fruit still green, showing a very slow process of ripening.
Pico						
16	18	2	5	4	36°F. (2.22°C.)	Fruits yellowish green. Dull grey colored areas found in some fruits.

a As to use of term "sound" see page 446.

ANGIOMA CAVERNOSUM HYPERTROPHICUM IN A CARABAO BULL: A CASE REPORT[1]

By Miguel Manresa

Of the College of Veterinary Science

WITH ONE PLATE

During a trip made by the writer to the town of Odiongan, province of Romblon, his attention was called to a carabao with a large tumor hanging from the neck. The natives of that locality called it "a bead of abnormal flesh". The owner of the carabao was very anxious to know whether the tumor could be removed, because it interfered greatly with the movement of the animal.

The carabao with the tumor was a huge bullock. When born sixteen years ago, a small swelling or a new growth was observed on the dorsal part and a little to the left side of the neck. The new growth did not grow larger while the animal remained a bull. The animal was castrated when about six years old. Soon after castration the growth began to enlarge rapidly. As it increased in size and weight it descended to the lower part of the neck. When seen by the writer, its base was nearly median in position and a little to the left of the presternal region. Laymen of the locality believe that castration stimulated the rapid growth of the tumor.

The animal's usefulness was not greatly affected. Even when the tumor had attained an enormous size, the carabao was used for doing hard work in the fields. During the last year the tumor became so large that it was very burdensome; it was difficult for the animal to walk, because its forelegs could not be advanced without hitting the tumor which reached to the ground.

Viewed from the left (Plate I, fig. 1) the appearance of the neoplasm suggests an elongated mulberry-like growth with seven large nodes each the size of a husked coconut. Several smaller nodes were attached to the upper part and posteriorly. The smaller nodes are again divided into lobules. The principal mass of the tumor, as seen from the right side, can well be compared to the pendulous scrotum of an aged stallion. The pendant portion of the tumor mass showed scars evidently due to injuries of the lowest parts.

Mohler (1 p. 301) defines tumors as "abnormal masses of tissue, noninflammatory and independent in character, arising without obvious cause, from cells of pre-existent tissue, possessing no physiologic function, and characteristically unrestrained in growth and structure." The essential difference between benign and malignant tumors is that the former do not tend to produce death, while the latter are invariably pernicious and tend from the beginning to destroy life. The definite nature of the tumor must be established before a veterinarian can recommend a line of treatment.

At the time of examination of the bullock under discussion the pulse rate-36, respiration-24, and temperature-38.2° C. could be accepted as normal. Manipulation and pressure on the large irregularly lobulated tumor mass caused no discomfort whatever; more or less circumscribed regions of dense induration could

[1] Experimental Station contribution, No. 283.

be felt. In the constricted portion by which the large tumor mass was attached to the body, the connective tissue was softer and, by palpation, a number of thick-walled blood vessels could be recognized. Pulsation was marked and could be easily detected. Examination and palpation of the external parts of the body, as well as a careful exploration of the rectum for the purpose of detecting metastatic tumors, failed to show such complications. The slow development, absence of systemic disturbance, and continuous well-being of the carabao, indicated that the tumor was benign.

The owner was advised that all indications permitted us to assume that an operation for removal of the large pedunculated mass would prove successful. The animal was properly secured and local anaesthesia by means of cocaine hydro-chloride solution was attained. The tumor was removed by simple excision from its base. Several large thick-walled arteries as well as veins were secured by firm ligatures. It was found that the tumor mass was abundantly supplied with blood vessels. The largest artery could be compared to the posterior radial in a Philippine pony. When excision had been completed a semicircular wound about thirty-five centimeters long remained. This defect was closed by interrupted sutures. Tincture of iodine was used freely, followed by a liberal application of tar ointment over the sutured skin. Soon after being released from the casting ropes, the carabao picked up grass. No serious postoperative hemorrhage followed. The local inflammation was not severe, the wound healing rapidly without complications. Fifteen days after the operation the carabao appeared normal in every way.

Figure 2, Plate I, shows the mass of tissue that was removed. It weighed 9,500 grams. On section, macroscopically the presence of spaces of various sizes surrounded by a framework of tough connective tissue was disclosed. The larger spaces were found to be irregularly arranged circular or sinuous cavities filled with indurated blood which was laminated in structure. The smaller spaces contained non-coagulated blood. On histologic examination, the blood vessels appeared as thin-walled tubes with flattened endothelium. The lumen were filled with blood cells. Broad fibrous connective tissue formed the interstices of the vessels, hence the diagnosis as *Angioma cavernosum hypertrophicum.*

COMMENTS

So far as the writer is aware, *Angioma cavernosum hypertrophicum* (angio-endothelioma) in the *Bubalus* species, either congenital or in adult life, has not been reported. Sparapani (2) found a reniform tumor (angio-fibroma) as large as a large nut on the placentar chorion of a bitch that had aborted after five weeks of pregnancy. In the human (3) vascular formations in the form of *Haemangioma simplex* are fairly common. They are usually congenital, occurring most frequently in the skin and sub-cutaneous tissue and are often found in places where fetal clefts have closed. This is what probably occurred in the case under discussion. It is possible that the new growth formed during embryonic life as haemangioma simplex near the cervical fissure. When the fetus assumed the normal dorso-sacral position, the tumor, having enough weight, gravitated a little to one side of the neck. In the adult animal, the constant irritation caused by the yoke undoubtedly furnished the stimulus for rapid development and growth of the tumor.

LITERATURE CITED

(1) Mohler, John R. *et al.* Special report on diseases of cattle. 568 pp. U. S. Department of Agriculture, Washington, 1916.
(2) Sparapani, Carlo. Angio-fibroma. American Veterinary Review **43**: p. 650. 1913.
(3) Ziegler, Ernest. A general pathology. 582 pp. New York, 1921.

ILLUSTRATIONS

Plate I

Figure 1. Left side of the carabao showing the tumor.
Figure 2. The tumor after its removal. Weight: 9,500 grams.

Figure 1:—Left side of the carabao showing the tumor.

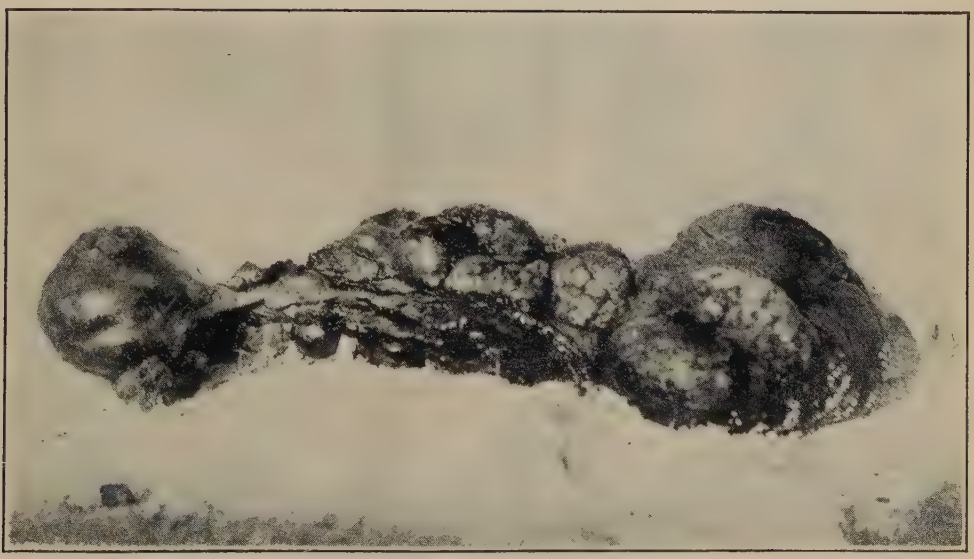

Figure 2: —The tumor after its removal. Weight: 9,500 grams.

PLATE I.

NOTE: HASTENING THE GROWTH OF PLANTS BY ARTIFICIAL LIGHT[1]

The article describes experiments of Professor Hugh Findlay of the Department of Agriculture of Columbia University showing the possibility of hastening the general development of certain plants and accelerating the appearance of blossoms by means of exposure to artificial light. The experiments, the results of which are discussed in the article, are said to have been conducted in April, 1923.

It is reported that seedlings have been made to germinate, grow to maturity, and bloom under artificial light in half the time required to grow the plant under sunlight alone. The plants grown under artificial light in addition to sunlight are said to show twice the vigor of plants grown under sunlight only. It is stated that there is an increased expense of production due to the cost of electric light, but with high-priced plants and with those which are of high value during certain seasons of the year the cost is not a big item.

According to the article a firm of nurserymen on Long Island tested the effect of electric light from huge electric bulbs on seedlings and older plants. The lights were turned on during the night and were allowed to shine for five hours. It is reported that after a short time the plants which were exposed to both sunlight and artificial light were much larger than those exposed to the sun alone.

The paper suggests that plants should not be exposed to the electric light continuously because they require certain periods for rest as animals do. It is likewise stated that different kinds of plants respond to electric light in different degrees; foliage plants are more favorably affected than are root crops.

The experiments discussed in the paper are said to have been conducted partly under the auspices of the Westinghouse Electric Company. Ten clear glass bulbs, each 500 watt and 110 volt were rigged in such a manner that they automatically turned on at 9:00 o'clock at night and shut off at 2:00 o'clock in the morning every night for five weeks. In this manner it is reported that plants illuminated artificially at night grew more rapidly and bloomed eight days earlier than those exposed to the sun alone, or their control.

The ten electric bulbs with their reflectors were hung in a row about 7.5 centimeters (about three inches) apart. The lamps had an adjustment range of about 30.5 to 244 centimeters (one to 8 feet). They were kept at 91.5 centimeters (36 inches) above the bench where the plants were. It is said that the temperature was raised about 12.2° C. (22° F.) higher than the average temperature range in the greenhouse during the day on account of the size and number of bulbs used. It is, however, reported that farther experiments are being carried on by Professor Findlay testing the effect of water jackets around the electric lamps in order to prevent the rise of temperature.

G. O. Ocfemia,
Of the Department of Plant Pathology.

[1] An article by M. Tevis in a recent number of **St. Nicholas Magazine**, portions of which are published in the **American Review of Reviews, 69:** p. 103. 1924.

ABSTRACT[1]

Nut fall of coconuts. C. J. Gadd. (*Bulletin 53, Department of Agriculture, Ceylon*).—The work reported in this bulletin consists of observations to ascertain the cause of the nut fall, and suggestions based on these observations for preventing the fall. Reports of work done by other men on the subject are included.

The author divided the fallen immature nuts into "button fall", or those that fall while very young; and "nut fall", or those that fall when they are about half grown. While some writers attribute the nut fall to lack of fertilization, they offer no proofs based on experiment. From this report it appears that button fall is largely due to the overproduction of female flowers. Hence there are more fruits than can possibly be supported by the mother plant to maturity. This would show that nut fall is a natural consequence rather than a result of a diseased condition. Insufficient or defective nutrition may also cause nut fall. The fruits that are in the best position to get the food supply develop while those that are situated at the edge of the branches are likely to be cast off. Drought is likely to cause button fall. Copeland, however, believes that this is uncertain.

Nut fall may be caused by the attack by fungi particularly *Phytophthora* sp., which may occur on the nut itself or on the fruiting branch. It may be caused by purely mechanical injury. In Jamaica and Ceylon, it has been found that a similar fungus which discolors the husk causes the nut fall. In some instances, however, the nuts show no discoloration immediately after falling, but the discoloration takes place within 24 hours. In this case the fungi may be found on the main branch, or the main branch may be simply fractured or split. The splitting of the branch is not due to disease, but rather is the result of some mechanical injury, usually caused by the weight of the nuts being more than the branch can support. This happens when the leaf upon which the fruiting branch rests (and which acts as additional support) falls through some cause.

The fall caused by mechanical injury can easily be prevented by propping. The one caused by disease may be prevented by spraying with Bordeaux mixture as soon as the flowers open. The result of the spraying experiment reported in the bulletin is, however, not very conclusive as to the advantage of spraying.

—*Abstract by Felix M. Esguerra.*

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[1] Abstract prepared as part of the required theme work in English 101, College of Agriculture.

EXCHANGE NOTES

In Denmark the universal use of electrical energy has brought most of the comforts and some of the attractions of modern civilization to the countryside, where contented people labor with a light heart.

—*Agricultural Gazette* (New South Wales).

Certain countries in the tropics are noted for the quantity of their agricultural products while others are renowned, not so much for the quantity as for quality. This circumstance appears to be deserving of greater attention than is usually given to it * * * Quality is clearly a very abstruse problem and the attention that is being given to its investigation at the Imperial College of Tropical Agriculture is likely to provide interesting results. All crops, in all stages, need consideration. * * * Needless to say, the great economic advantage of quality is that it possesses a special market significance. It means a premium. It often means a monopoly and consequently a much wider and less variable margin between cost of production and value. This is an age of novelty and luxury. Selection for quality pays. Special grades of distinction can always be sold because they can always be advertised, directly or indirectly. Small total production for quality with a high cost of production may answer on many an estate. Only a big total production with a low cost of production is safe where quality and distinctiveness are not aimed at. Even then there must be a market. Is this not pertinent at a time when many industries are suffering from depression?

—*Tropical Agriculture.*

Quebracho, mimosa, mangrove, chestnut, and oak are the tanning materials most frequently used by Polish tanners. * * * The domestic production, however, is only able to cover a small portion of the demand either for quality or kind, and tanning barks and extracts are imported in large quantities from the following original sources: Quebracho from Argentina and the United States; mimosa from South Africa; mangrove from Madagascar; chestnut from France, Italy, and Yugoslavia; and oak from Germany, Yugoslavia, and Hungary.

—*Commerce Reports* (U. S. Department of Commerce).

Coöperative marketing will be taught in the public schools of Oklahoma in connection with other agricultural studies * * * The book, "The Business of Farming" was adopted for use for a period of five years.

—The *California Cultivator.*

Leg weakness or rickets in young chicks can be prevented and cured by direct sunlight. The direct rays of the sun produce the same effect in growing bone as does vitamine "D" in cod liver oil. There are two methods to use in growing bone, either give direct sunlight, or provide the vitamines.

—The *Agricultural Student* (College of Agriculture, Ohio).

Palm oil finds a varied application in industry according to its free fatty acid content. While an oil of medium quality is employed largely in the preparation of soaps, candles, lubricating greases and in the manufacture of tinplate, an oil with a minimum quantity of free fatty acids, 2 to 4 per cent, can be used for edible fats. Hitherto the quantity of such high grade palm oil available has been limited, but, with regular supplies, it should be able to compete with either coconut oil or palm kernel oil, since it has been proved that high quality palm oil forms an excellent basis for the preparation of substitute butter and cooking fats.

—The *Malayan Agricultural Journal.*

A number of organizations and individuals are attempting to designate goat meat by a special name which will be comparable to pork, beef, and mutton. The name selected by the goat-raising interests in the Southwest is "chevon". * * * It (the word) was made by combining parts of two French words—"chevre" meaning goat, and "mouton", meaning mutton. In other words, "chevon" means goat mutton.

—The *Official Record* (U. S. Department of Agriculture).

No other economic plant has such a wide geographical range as *Nicotiana tobaccum* and no custom is more widely practised than that of smoking.

—*Tropical Agriculture.*

The United States Department of Agriculture carried out experiments which resulted in a bread being prepared in which from 8 to 10 per cent. of the flour used was substituted by cacao powder, and the shortening usually supplied was omitted, as this is supplied by the cacao, presumably by the fat which it contains. This bread has now been manufactured in Trinidad according to the United States recipe and has been pronounced by many who have tried it to be very palatable and likely to meet with some demand. If such a demand became general the consumption of cacao might be increased.

—*Tropical Agriculture.*

Seventeen champion young farmers and home makers came from Indiana recently to visit the department and other points of interest in Washington, on an educational trip given them by several state organizations in recognition of their superior accomplishments in club work. They were greeted by the Secretary at the department and received at the White House by the President. They made a trip to Mount Vernon to see the farm and home of our first farmer President and few, if any, of the other points of interest in and about the city escaped them. * * *

These young exponents of the farm's opportunities for notable achievements were chosen for this trip from the 16,000 club members enrolled in Indiana, competing with boys and girls in 90 counties. The girls won their trip by excelling in caring for home; bread making, canning fruit, vegetables, and meat; baking, sewing, etc. The boys by ranking first in production of crops and live stock raising; two orchardists had sprayed and cared for 2,665 and 800 trees, respectively.

—The *Official Record* (U. S. Department of Agriculture).

COLLEGE AND ALUMNI NOTES

Mr. Theodore R. Gardner, Mr. Curtis P. Clausen, and Mr. H. A. Jaynes, entomologists with the U. S. Department of Agriculture, spent part of the first week in January on the Campus. These gentlemen have been in the orient for some years specializing in breeding parasites destructive to insect pests found in the United States. Mr. Haynes has been working in China and Messrs. Clausen and Gardner in Japan. Their visit in the Philippines is one of observation only.

Mr. Masato Ishida, government entomologist, and Mr. A. Daibo, assistant entomologist, Sugar Experiment Station, Tainan, Formosa, visited the College of Agriculture on January 6. They were on their way to Negros and other large sugar-growing districts. They are planning to go to Federated Malay States, Java, and other oriental countries for the purpose of collecting parasites of the woolly aphis of sugar cane leaf (*Oregma lanigera* Zehnter), and colonizing them in Formosa.

The Rev. Norman C. Schenck of Honolulu was a recent Campus visitor. Mr. Schenck is interested in Welfare Work among the Filipino laborers in Hawaii and is spending a few months in the Philippines to become more familiar with the conditions here.

Dr. Felix Frankl and Miss Gisela Spitzer, of the faculty of Kwantung National University, Canton, China, a state institution, are temporary residents on Faculty Hill. They will spend some months in the Philippines with the object of studying economic conditions.

During the Christmas recess, accompanied by Professor Hester, Head of the Economics Department, Doctor Frankl and Miss Spitzer made a three-day observation trip embracing the highland towns of Laguna: Cavinti, Luisiana, and Mahayhay. Professor Hester reported on his return on the remarkable industry of Luisiana. The town with 5000 inhabitants and no access by any type of wheeled vehicle to the outside world produces and exports ₱6000 worth of buri hats, copra, pandan hats, copra, and pandan, weekly. The town produces five-twelfths of its annual rice requirements and its active population is terracing the flanks of Mount Banahao in the hope of producing the remaining seven-twelfths. The town is clean and its officials active.

Mr. Elliott, a prominent Student Y. M. C. A. Secretary from the United States, made an address before the Student Body on January 5.

Prof. Inocencio Elayda, after serving the Bureau of Agriculture for a period of five months in the capacity of Assistant Director of Agriculture *ad interim*, was reinstated by the Board of Regents of the University of the Philippines in his former position in the College of Agriculture as Director of Extension Serv-

ice. He was transferred to the Bureau of Agriculture at the request of the Governor General and the Secretary of Agriculture and Natural Resources, but his *ad interim* appointment was not favorably acted upon by the Senate.

During the Christmas recess, Prof. E. Gertrude Madison, of the English Department, attended the Seventh Young Women's Student Conference at Baguio. Professor Madison addressed the Conference on: "The Filipino woman in the home" and "The Filipino woman in her social and public life" and presided at the Open Forum which followed each address.

For the purpose of seeing something of the cattle industry in Australia, Dr. B. M. Gonzalez, Head, Animal Husbandry Department, College of Agriculture, Dr. Gregorio San Agustin and Dr. Marcos Tubangui of the College of Veterinary Science, and Prof. Barney Sarecky of the Forest School made a three weeks trip to Australia in the holidays recess.

The trip was made possible through the courtesy of Messrs. Soriano and Buencamino, cattle importers of Manila who had chartered the steamer "Pronto" to bring cattle from Australia and made room for the professors on the ship.

Mr. Mariano Lopez of Washington, D. C., has been appointed assistant professor of economics in the College of Agriculture.

Mr. Simon Santos has been added to College staff as instructor in physical culture.

A bountiful dinner and a rousing good time was provided on New Year's Day for all students remaining on the Campus. The idea originated with Dean Baker who gave his plan a vigorous start with a generous contribution. Members of the Faculty followed with "dinero" which made a sum sufficient to give a good dinner and provide prizes.

The dinner was served in the "Y" dining hall. The principal after dinner speaker was Dean Baker whose speech was hailed as "fine", "Bakeresque" by the students. The program and games which followed the dinner owed their success largely to Mrs. Robert L. Pendleton, Doctor Espino and a committee of students. It was a jolly New Year's Day for all.

Mr. Yñiguez, Chief Clerk, and the General Office staff were prominent in the management of the Los Baños Rizal Day celebration.

The Fifth Intramural Track and Field Meet of the Los Baños Colleges was held on January 10 and 11. A detailed account will be published in the June issue of the PHILIPPINE AGRICULTURIST.

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